NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 2003 BUDGET ESTIMATES

NASA'S VISION FOR THE FUTURE

NASA is an investment in America's future. Since 1958 when NASA was created, the Agency has pursued a fundamental mandate---to pioneer the future. As explorers, pioneers, and innovators, we boldly expand frontiers in air and space to inspire and serve America and to benefit the quality of life on Earth. NASA's primary charter is to explore the new frontiers of science and technology using innovative technologies.

NASA's unique mission of exploration, discovery, and innovation has preserved the United States' role as both a leader in world aviation and as the preeminent spacefaring nation. It is NASA's mission to:

- Advance human exploration, use and development of space;
- Advance and communicate scientific knowledge and understanding of the Earth, the Solar System, and the Universe;
- Research, develop, verify and transfer advanced aeronautics and space technologies.

The outcomes of NASA's activities contribute significantly to the achievement of America's goals in five key areas:

- Economic growth and security - NASA conducts aeronautics and space research and develops technology in partnership with industry, academia, and other federal agencies to keep America capable and competitive.
- Increased understanding of science and technology – NASA communicates widely the content, relevancy, and excitement of our mission and discoveries to inspire and increase the understanding and the broad application of science and technology.
- Protection of Earth's Environment - NASA studies the Earth as a planet and as a system to understand global climate change, enabling the world to address environmental issues.
- Educational Excellence - NASA involves the educational community in our endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds.
- Peaceful Exploration and Discovery - NASA explores the Universe to enrich human life by stimulating intellectual curiosity, opening new worlds of opportunity, and uniting nations of the world in this quest.

Achieving our goals and objectives over the first quarter of the 21st century will contribute to national priorities: the protection of Earth's fragile environment, educational excellence, peaceful exploration and discovery, and economic growth and security.

STRATEGY FOR ACHIEVING OUR GOALS

The NASA budget request for FY 2003 reflects a strong commitment and emphasis to continue to build on the Agency's core foundation of aeronautics and aerospace research and development. In its pursuit of science and technology, NASA will continue to use its missions of exploration and discovery to educate and inspire—all for the benefit of life on Earth.

Included in this request are both near-term priorities–flying the Space Shuttle safely and continuing to build and operate the International Space Station–and longer-term investments in America's future–developing more affordable, reliable means of access to space and conducting cutting-edge scientific and technological research. It draws on NASA's strengths in engineering and science and reflects the revolutionary insights and capabilities on the horizon in areas such as biotechnology, nanotechnology, and information technology. It describes our vision for expanding air and space frontiers, serving America, and improving life on Earth. This budget request also fully supports the President's Management Agenda which calls for all Federal agencies to measure performance and results. NASA will examine its Agency management practices including its operational and institutional infrastructure, its workforce, and its cost/resources management, and identify and implement needed improvements in Agency management and performance.

The President's FY 2003 budget request for NASA supports the above goals through the following three appropriations:

Human Space Flight (HSF) - provides funding for HSF activities, and for safety, mission assurance and engineering activities supporting the Agency. HSF activities include development and operation of the Space Station and operation of the Space Shuttle. This includes development of high priority investments to improve the safety of the Space Shuttle, revitalization of aging Shuttle infrastructure, and required construction projects in direct support of the Space Station and Space Shuttle programs. This appropriation also provides for salaries and related expenses (including travel); design, repair, rehabilitation, and modification of facilities and construction of new facilities; maintenance, and operation of facilities; and other operations activities supporting human space flight programs; and space operations, safety, mission assurance and engineering activities that support the Agency.

Science, Aeronautics and Technology (SAT) - provides funding for the science, aeronautics and technology activities supporting the Agency. These activities include Space Science, Biological and Physical Research, Earth Science, Aerospace Technology, and Academic Programs. This appropriation also provides for salaries and related expenses (including travel); design, repair, rehabilitation, and modification of facilities and construction of new facilities; maintenance, and operation of facilities; and other operations activities supporting science, aeronautics, and technology programs.

Inspector General – provides funding for the workforce and support required to perform audits and evaluations of NASA's programs and operations.

The NASA FY 2003 budget request helps position the Agency to explore and possibly answer fundamental questions outlined in the NASA Strategic Plan:

- How did the Universe form and evolve, and does life exist elsewhere?
- How do we best observe and understand our home planet, learn how it is changing, and help determine and understand the consequences for life on Earth?

- Can we enable safe and permanent human habitation of space, creating a laboratory to test the fundamental principles of physics, chemistry, and biology?

- What cutting-edge technologies, processes, techniques, and engineering capabilities must we develop to enable our research agenda?

- How can we enable revolutionary technological advances to provide faster, safer and less expensive air and space travel?

- How can we most effectively transfer knowledge and technology for commercial benefit and to better the quality of life for all Americans?

The NASA Strategic Plan describes how we will pursue our vision, implement our mission, and seek answers to fundamental questions of science and technology that provide the foundation for our goals and objectives. NASA's strategic architecture consists of the following five Strategic Enterprises: Space Science, Earth Science, Human Exploration and the Development of Space, Biological and Physical Research, and Aerospace Technology. These Strategic Enterprises are NASA's primary mission areas.. These goals and objectives represent a balanced set of science, exploration, and technology development outcomes that we believe can be accomplished over the next 25 years.

ENTERPRISE PLANS AND ACCOMPLISHMENTS

Human Exploration and the Development of Space (HEDS)

The HEDS Enterprise seeks to expand the frontiers of space and knowledge by exploring, using, and enabling the development of space. HEDS asks questions to improve human possibilities both on Earth and in space. How do we design systems to make possible safe and efficient human exploration and commercial development of space? What are the resources of the solar system? Where are they? Are they accessible for human use? How can we ensure that humans can be productive in and beyond Earth orbit? HEDS is building the International Space Station to provide a continuously operating research platform and to prepare the way for robotic and human exploration even farther into space.

Space Station

The International Space Station (ISS) is a complex of research laboratories in low Earth orbit in which American, Russian, Canadian, European, and Japanese astronauts are conducting unique scientific and technological investigations in a microgravity environment. The goal of the Station is to support activities requiring the unique attributes of humans in space and establish a permanent human presence in Earth orbit. The President's Budget request provides funding for continued development of the vehicle and for operations in support of continued assembly, logistics resupply, crew exchange, research operations and other utilization. As required by both the Authorization Act (PL 106-391) and the 2002 Appropriations Act (HR 2620), the ISS research budget is transferred to the BPR Enterprise in FY 2002.

Since July 2000, 20 (9 U.S. and 11 Russian) successful Space Station missions have been completed. Flights in calendar year 2001 deployed the U.S. Laboratory, research equipment necessary for conducting experiments on the Space Station, the Canadian robotic arm, the Russian docking compartment, and transported the 3rd and 4th crew expeditions. By mid-calendar year 2001, the U.S. Airlock had been installed, allowing spacewalks to be conducted without the Space Shuttle present, and marking completion of Phase 2 of the Station assembly. The first utilization flight in December 2001 greatly expanded the number of research payloads on-orbit, and raised the number of research investigations initiated to over 40. Crew training, payload processing, hardware element processing, and mission operations were supported without major ground anomalies, and all but two on-orbit subsystems performed above predicted levels.

During 2002, three of the major truss elements constituting the power block will be deployed to orbit, Expeditions 5 and 6 will be deployed, and a second utilization flight will further expand science capabilities. In calendar year 2003, activation of the thermal system will be completed, two of the three remaining solar array modules will be deployed, and both the S6 truss and Node 2, the final components of the U.S. Core, should be delivered to NASA for final integration and pre-flight test and checkout to support planned launches in calendar year 2004.

Consistent with the recommendations from the ISS Management and Cost Evaluation (IMCE) Task Force and the Administration, NASA will develop a Cost Analysis Requirements Description (CARD) to support cost estimates of the U.S. core complete baseline. NASA will also develop an integrated management action plan based on recommendations of the IMCE Task Force, and begin implementation of those actions. A NASA cost estimate, and an independent cost estimate (ICE) of the cost to assemble and operate the U.S. core complete will be completed by September 2002. NASA will also report to the Administration and to Congress its plans for a non-governmental organization (NGO) for ISS research, identify and pursue innovative approaches such as automation and increased crew availability to improve Space Station's research productivity, and the results of discussions with the International Partners regarding ways to increase on-orbit resources for station research.

Space Shuttle

The Space Shuttle is a partially reusable space vehicle that provides several unique capabilities to the United States space program. These include: retrieving payloads from orbit for reuse; servicing and repairing satellites in space; safely transporting humans to and from space; launching ISS components and providing an assembly platform in space; and operating and returning space laboratories. In FY 2001 and FY 2002, the Space Shuttle launched seven flights per year, all of which were assembly and servicing missions for the International Space Station, except for a Hubble Space Telescope Servicing Mission (HST SM-3B). In FY 2003, four flights are planned, all of which are ISS assembly and servicing missions. The President's Budget supports key Space Shuttle safety investments as part of NASA's Integrated Space Transportation Plan, allocates additional funding for infrastructure revitalization and will aggressively pursue Space Shuttle competitive sourcing as an important step in transitioning NASA to purchasing space transportation services where possible.

Payload and Expendable Launch Vehicle (ELV) Support

The Payload Carriers and Support program is the "one-stop shopping provider" for all customer carrier needs and requirements for safe and cost effective access to space via the Space Shuttle. During FY 2001 and 2002, Payload Carriers and Support provided services for every Space Shuttle mission. The ELV Mission Support budget provides funds for technical and management insight of commercial launch services inclduing advanced mission design and analysis and leading-edge integration services for the full range of NASA missions under consideration for launch on ELVs. During FY 2001, eight ELV missions were launched. Integration and technical management of 11 launches, including one secondary, are planned in FY 2002, and in FY 2003, support for ten launches, including one secondary, is planned.

Investments and Support

The Rocket Propulsion Test Support activity will continue to ensure NASA's rocket propulsion test capabilities are properly managed and maintained in world class condition. Engineering and technical base (ETB) activity will continue to support the institutional capability in the operation of space flight laboratories, technical facilities, and testbeds; to conduct independent safety, and reliability assessments; and to stimulate science and technical competence in the United States. The Crew Health and Safety program was transferred from the Biological and Physical Research Enterprise beginning in FY 2003. Funding for other direct costs associated with Human Space Flight, which were funded in the Mission Support account prior to FY 2002, are also funded within investments and support. This includes research and program management costs and non-programmatic construction of facilities costs.

Space Communications and Data Systems

This program supports NASA's Enterprises and external customers with Space Communications and Data System (SCDS) services that are responsive to customer needs. In addition, the program performs infrastructure upgrades and replenishment efforts necessary to maintain the service capability that satisfy NASA's approved missions, and conducts technology and standards infusion efforts to provide more efficient and effective services. NASA Headquarters manages and directs an integrated Agency-wide Space Communications and Data Systems program.

Beginning in FY 2002, consistent with NASA's moves towards full cost, NASA will transfer management and budget responsibility for Space Communications and Data Systems capabilities to those Enterprises that are the primary users of those capabilities. Beginning in FY 2003, the Deep Space Network, Ground Network and Western Aeronautical Test Range will be managed by the Space Science, Earth Science, and Aerospace Technology Enterprises, respectively. The HEDS Enterprise will continue to perform overall program coordination, including the management of Consolidated Space Operations Contract, which is now in its fourth year.

The TDRS-H spacecraft, which completed on-orbit checkout in September 2000, is working well and meets all user service telecommunications performance requirements except for a Multiple Access (MA) performance anomaly. Modifications to the TDRS-I

and –J spacecraft flight hardware and test program as a result of the MA investigation have been implemented. TDRS-I launch is currently planned for February 2002. The launch of TDRS-J is slated for October 2002.

Safety, Mission Assurance and Engineering

The Safety and Mission Assurance program invests in the safety and success of NASA missions by assuring that sound and robust policies, processes, and tools for safety, reliability, quality assurance, and engineering disciplines are in place and applied throughout NASA. The program also examines long-term technology requirements for NASA's strategic objectives. The Engineering program, managed by the Office of the Chief Engineer (OCE), oversees the conduct and improvement of NASA's engineering practice and independently evaluates ongoing programs, proposed concepts, and options for new programs.

Space Science

The activities of the Space Science Enterprise seek to chart the evolution of the universe, from origins to destiny, and understand its galaxies, stars, planetary bodies, and life. The Enterprise asks basic questions that have eternally perplexed human beings: How did the universe begin and evolve? How did we get here? Where are we going? Are we alone? The Space Science Enterprise develops space observatories and directs robotic spacecraft into the solar system and beyond to investigate the nature of the universe.

The quest for this information, and the answers themselves, maintains scientific leadership, excites and inspires our society, strengthens education and scientific literacy, develops and transfers technologies to promote U.S. competitiveness, fosters international cooperation to enhance programs and share their benefits, and sets the stage for future space ventures.

The Space Science program seeks to answer fundamental questions concerning: the galaxy and the universe; the connection between the Sun, Earth and heliosphere; the origin and evolution of planetary systems; and the origin and distribution of life in the universe. The program is comprised of a base program of' many research and development activities, including flight missions, major space-based facilities, technology and mission development programs, and research and data analysis.

In 2001, the Space Science program produced many notable scientific results.

- The Hubble Space Telescope discovered a supernova blast that occurred very early in the life of the Universe, bolstering the case for the existence of a mysterious form of "dark energy" pervading the Universe.
- Chandra took the deepest X-ray images ever and found the early Universe teeming with black holes, probed the theoretical edge of a black hole's event horizon, and captured the first X-ray flare ever seen from the supermassive black hole at the center of our own Milky Way galaxy.
- Detailed scientific analysis of high-resolution images obtained by the BOOMERANG (Balloon Observations of Millimetric Extragalactic Radiation and Geophysics) mission provided the most precise measurements to date of several of the key characteristics cosmologists use to describe the Universe.

- NASA and National Science Foundation-funded astronomers discovered eight new extrasolar planets, bringing the total number of extrasolar planet detections to about eighty.
- The Deep Space-1 spacecraft successfully navigated past comet Borrelly, giving researchers the best look ever inside a comet's glowing core of ice, dust and gas.
- The NEAR (Near Earth Asteroid Rendezvous) Shoemaker spacecraft achieved the first ever soft landing on an asteroid.
- A pair of spacecraft, the Mars Global Surveyor and the Hubble Space Telescope, provided astronomers with a ringside seat to the biggest global dust storm seen on Mars in several decades.
- The Mars Odyssey 2001 spacecraft successfully achieved orbit around Mars following a six month, 286 million mile journey. Following aerobraking operations, this spacecraft will be placed in its science mapping orbit in early 2002 and will characterize composition of the Martian surface at unprecedented levels of detail.
- The Solar and Heliospheric Observatory (SOHO) observed the largest sunspot in ten years, with a surface area as big as the surface area of thirteen Earths.
- The year was capped by the successful launch of the TIMED (Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics) mission on December 7, 2001 to study a region of the Earth's atmosphere that has never been the subject of a comprehensive, long-term scientific investigation.

The NASA budget request for FY 2003 features two very significant changes from the previous baseline program: a reformulated planetary program and the inclusion of a nuclear power and propulsion program. In the field of planetary exploration, the FY 2003 budget takes a fundamentally different approach from previous years. Given cost growth and schedule delays, all funding for the Pluto-Kuiper Belt mission and the Europa Orbiter mission has been eliminated in FY 2003 and subsequent years. These missions will be replaced by a revamped planetary program that will incorporate the following principles: clear science priorities that support key goals in understanding the potential existence of life beyond Earth and the origins of life,open competition and rigorous reviews of cost, schedule, and risk to minimize future overruns and delays per the highly successful Discovery Program; and an architectural approach that balances science return in this decade with investments in high-leverage technologies that will enable faster and more frequent missions with greater science return in the next decade. It is envisioned that the new planetary program will be structured and managed along the lines of the highly successful Discovery program. A key element of this new program will be the development and incorporation of nuclear power and propulsion technologies. Building upon ongoing NASA investments in advanced electric propulsion and instrument and electronics miniaturization, investments in nuclear power and nuclear-electric propulsion will enable much faster and more frequent planetary investigations with greater science capabilities. These investments will allow NASA to undertake fundamentally new approaches to planetary exploration. In the next decade, nuclear electric propulsion technology will enable affordable missions that: can reach targets in half the time it would take using today's propulsion systems, are not limited by today's power and mass constraints; and can conduct long-term observations of multiple targets.

Nuclear power technology will also be incorporated into the Mars Exploration Program, specifically in the Mars Smart Lander/Mobile Laboratory mission. This mission will now be launched in 2009 to allow the incorporation of nuclear power, instead of 2007 as previously planned. By using nuclear power, the time during which the Mars Mobile Laboratory can conduct science operations will be extended from several months to several years. The nearer-term missions in the Mars Exploration Program

remain essentially unchanged. In May and June of 2003, two highly capable surface rovers will be launched to Mars, with landings on the surface expected in April and May of 2004. The Mars Reconnaissance Orbiter (MRO) will be launched in 2005. This powerful scientific orbiter will analyze the surface of Mars at unprecedented levels of detail to follow tantalizing hints of water detected in images from the Mars Global Surveyor spacecraft. MRO will measure thousands of Martian landscapes at 20- to 30-centimeter (8 to 12-inch) resolution. It will be followed by a competitively selected Mars Scout mission in 2007, and then the Smart Lander/Mobile Laboratory in 2009. This robust program of orbiters, landers, and rovers is poised to unravel the secrets of the red planet's past environments, the history of its rocks, the many roles of water and, possibly, evidence of past or present life.

This budget supports the completion of development of many significant missions, including Gravity Probe-B (GP-B), the Space Infrared Telescope Facility (SIRTF), and the Stratospheric Observatory For Infrared Astronomy (SOFIA). GP-B, which will verify a key aspect of Einstein's theory of general relativity, will be launched in October 2002. SIRTF, the fourth and final of the Great Obervatories, is scheduled for launch in FY 2003. SOFIA development activities will continue, with the aircraft door and the telescope being installed and tested in 2003.

Development activities supporting the Solar Terrestrial Relations Observatory (STEREO), the Gamma-ray Large Area Space Telescope (GLAST), the final Hubble Space Telescope servicing mission, as well as several key missions in the payloads program such as Solar-B and Herschel, will also continue in 2003.

In the Explorer progam, the Microwave Anisotropy Probe successfully launched on June 30, 2001, and development of Swift, a multi-wavelength observatory for gamma-ray burst astronomy, remains on schedule for a September, 2003 launch. Another MIDEX mission, the Full-sky Astrometric Mapping Explorer (FAME), did not pass confirmation review due to cost increases and was not approved for full-scale development. Selection of the MIDEX-5 and MIDEX-6 missions will occur in 2002, and an Announcement of Opportunity for MIDEX-7 and MIDEX-8 will be released in 2003. In the Small-class (SMEX) mission series, three NASA missions and two non-NASA Missions of Opportunity are supported. The NASA missions include the Galaxy Evolution Explorer (GALEX), Two Wide-Angle Neutral Atom Spectrometers (TWINS), and the High Energy Solar Spectroscopic Imager (HESSI). The Missions of Opportunity are the Coupled Ion Neutral Dynamics Investigation (CINDI) which is a cooperative mission with the Air Force, and ASTRO E-2, an X-ray astronomy mission (in cooperation with Japan) that will be a rebuild of ASTRO E, which was lost due to a failure of the Japanese launch vehicle in February 2000.

In the Discovery program, the Comet Nucleus Tour (CONTOUR), launched in July 2002, will encounter two comets, comet Encke in 2003 and comet Schwassman Wachman-3 in 2006.

The New Millennium program is providing flight demonstrations of critical new technologies that will reduce the mass and cost of future science and spacecraft subsystems, while maintaining or improving mission capabilities. In 2003, the Nanosat Constellation Trailblazer (Space Technology-5, or ST-5) will undergo spacecraft and instrument integration and test in preparation for launch in 2004. Also in 2003, the Critical Design Review for ST-6, the Confirmation Review for ST-7, and the initial confirmation for ST-8 will be conducted.

The FY 2003 budget also provides funding for focused technology programs in each of the following four major Space Science themes: the Astronomical Search for Origins; Structure and Evolution of the Universe; Solar System Exploration; and Sun-Earth Connections, which includes both the Living With A Star Program and the Solar Terrestrial Probes Program. These funds provide for early technology development in support of strategic missions such as the Next Generation Space Telescope and the Space Interferometry Mission. The goal is to retire technology risk early in a mission's life-cycle, before proceding to full-scale development. Funds are also provided to continue on-going operations of approximately thirty spacecraft, and to conduct robust reasearch and analysis, data analysis, and suborbital research campaigns.

Biological and Physical Research

The Biological and Physical Research (BPR) Enterprise affirms NASA's commitment to the essential role biology will play in the 21st century, and supports the high-priority biological and physical sciences research needed to achieve Agency strategic objectives. BPR will foster and enhance rigorous interdisciplinary research, closely linking fundamental biological and physical sciences in order to develop leading-edge, world-class research programs. BPR is dedicated to using the unique characteristics of the space environment to understand biological, physical, and chemical processes, conducting science and technology research required to enable humans to safely and effectively live and work in space, and transferring knowledge and technologies for Earth benefits. BPR also fosters commercial space research by the private sector towards new or improved products and/or services on Earth, in support of the Agency's mandate to encourage the commercial use of space.

In FY 2001, BPR was created as an independent research organization and a fifth strategic enterprise. During the year, BPR expanded its already significant interagency research efforts, and a BPR investigator received the Nobel Prize in physics for ground-based research that he plans to extend and expand on the ISS. Outfitting the ISS for research began with the delivery of the Human Research Facility in March 2001. Two research equipment racks were delivered to the ISS in mid-April, and an additional two at the beginning of Expedition 3 in August. BPR initiated a program of research on the ISS to take advantage of available resources during the construction phase. The ISS Expedition 1 and 2 Teams were able to meet the research objectives of the planned experiments, with only one unsuccessful experiment (due to technical reasons).

BPR will continue to increase knowledge and demonstrate key technology capabilities for humans in space, address critical questions in crew health and safety, and materials science and commercial research payloads will be flown. The Space Station research program is on-track to deliver added equipment racks to help achieve these goals. BPR is presently working toward completing definition studies and awarding a contract to manage ISS utilization to a Non-Governmental Organization (NGO). Working with the scientific community, its advisory committees, and the Administration, BPR plans to complete the development of research priorities across its portfolio of research endeavors to provide a basis for critical resource allocation decisions and optimize the use of ground- and space-based research capabilities. In the area of public outreach and education, this Enterprise plans to develop electronic and printed educational materials that focus on biological and physical research.

In FY 2003, BPR will implement its research priorities and develop ISS flight facilities to achieve a balanced and productive research program. Lab outfitting will continue with the planned delivery of three racks: the Window Observational Research Facility, Human Research Facility-2, and one EXPRESS Rack. Expeditions 6, 7, and 8 will carry out a variety of investigations in

the areas of biomedical, biotechnology, microgravity, materials science, and agriculture research, and conduct Earth observations. Through the "Space Radiation" and "Generations" initiatives, BPR will accelerate its efforts to understand and mitigate the effects of radiation exposure in space, and explore the ability of organisms to evolve in and adapt to the space environment over several generations. BPR will also work with Space Research Museum Network members to explore opportunities for the development of projects, special events, or workshops focused on the life sciences- and biology-related research themes to attract and engage public audiences. In addition, BPR will make available to wide audiences an online database of Commercial Space Center activities, including publications listings, patents, and other information useful to the general public.

Earth Science

The mission of NASA's Earth Science Enterprise (ESE) is to develop a scientific understanding of the Earth system and its response to natural and human-induced changes to enable improved prediction of climate, weather and natural hazards for present and future generations. The unique vantage-point of space provides information about the Earth's land, atmosphere, ice, oceans, and biota as a global system, which is available in no other way. ESE seeks to answer a question of fundamental importance to science and society: *How is the Earth system changing, and what are the consequences for life on Earth?* To do so, ESE has pioneered the interdisciplinary research field of Earth System Science, which recognizes that the Earth's land surface, oceans, atmosphere, ice sheets, and life itself all interact in a highly dynamic system. Earth system science is an area of research with immense benefit to the Nation, leading to new knowledge and tools that improve weather forecasting, agriculture, urban and regional planning, environmental quality, and natural disaster management.

ESE has established three goals to pursue in order to fulfill its mission: (1) Science – observe, understand, and model the Earth system to learn how it is changing, and the consequences for life on Earth; (2) Applications – expand and accelerate the realization of economic and societal benefits from Earth science, information, and technology; (3) Technology – develop and adopt advanced technologies to enable mission success and serve national priorities. ESE data products and research are a major contribution to the US Global Change Research Program.

In ESE Science, 2001 was another year of substantial accomplishment toward understanding the Earth system, with new global views of the Earth's biosphere and global land cover, of changes in the Antarctic and Greenland ice sheets, and of the role of atmospheric aerosols in inhibiting regional rainfall and influencing global climate. ESE also made major advances in computing for climate modeling, using a partnership among two NASA Centers and Silicon Graphics, Inc. to simulate 900 days of Earth's climate in one day, up from the prior capability of 70 days per day; performance on end-to-end climate simulation improved ten-fold. This greatly enhances the climate modelers' ability to perform the multiple runs of many years of climate simulations needed to generate useful projections of climate change. ESE will continue on this trajectory of improvement in computational climate modeling via a new partnership with 3 other agencies and 16 universities to define a shared modeling framework, and partnerships with industy to acquire the needed high-end computing capacity. With these tools, researchers can provide government and industry with the climate projections they need to make sound investment decisions in the years ahead.

In ESE Applications, ESE has entered into a variety of partnerships that will demonstrate the goods and services made possible by ESE's research. ESE provides QuikSCAT data in real time to the National Oceanic and Atmopsheric (NOAA) Administration to

improve marine weather forecasting, and has used these data to show that severe storms forming over the oceans can be predicted two days in advance. ESE is working with the Federal Emergency Management Agency (FEMA) to use remote sensing tools to update their flood plain maps throughout the U.S.. In a partnership called AG 2020 with U.S. Department of Agriculture (USDA) and four growers associations representing 100,000 farmers, ESE is demonstrating how to increase crop productivity, reduce risks to crop health, and manage environmental impacts. With National Institutes of Health (NIH), ESE is exploring the use of satellite data to predict spread of infectious diseases such as malaria that are highly influenced by weather and climate. Throughout the summer, three ESE satellites tracked devastating wildfires in the western U.S., providing data to the U.S. Forest Service (USFS) and regional authorities. As a result, USFS is investing in direct broadcast receiving stations to rapidly acquire data from NASA's Terra satellite.

In ESE Technology, the first ESE New Millennium Program satellite to demonstrate a variety of new technologies for Earth Science successfully completed all of its demonstration tasks except for one high risk propulsion task which is scheduled for near the end of mission life. These include a new instrument to produce a Landsat-type sensor one-fourth the size of the current Landsat 7 instrument, and the first hyper-spectral imager in space, which views the Earth's land surface in hundreds of spectral channels rather than the conventional 5 to 7. ESE is now working in partnership with the U.S. Navy and NOAA on its next New Millennium mission to make atmospheric temperature and humidity measurements from geostationary orbit. A host of partners in academia and other government labs are working with ESE to develop the next generation of new instruments and smaller, more capable spacecraft.

ESE is in the midst of deployment of the Earth Observing System (EOS), a set of spacecraft and associated interdisciplinary science investigations to initiate a long-term data set of key parameters required for the study of global climate change. The first six EOS satellites are already in orbit, including Jason-1 and Stratospheric Aerosol and Gas Experiment (SAGE) III launched in December 2001. The remaining EOS satellites will be launched through 2004, including Aqua (2002) to study the water cycle and atmospheric circulation to enable the next great advances in weather prediction, and Aura (2004) to probe the chemistry of the upper and lower atmosphere, the latter globally for the first time. Complementing EOS is a series of small, focused Earth System Science Pathfinder missions to explore Earth system processes never before examined globally from space, such as the first precise measurements of the distribution of mass in the interior of the Earth. Data from the EOS satellites already in orbit are being acquired, processed, and distributed by the EOS Data and Information System (EOSDIS), which is currently handling more than 1 terabyte of data per day. EOSDIS handled 12.3 million user queries for over 15 million products in 2000. EOSDIS continues to evolve as new satellites are launched, and as new partners are added to produce data products with innovative applications.

As it deploys EOS, ESE is also planning for the future. ESE and U.S. Geological Survey (USGS) released a request for proposal for Landsat Data Continuity Mission to succeed Landsat 7; it is being implemented as a commercial data purchase. ESE is also planning for the transition of several of its key research observations to the Nation's weather satellite system. The Department of Defense (DoD), NOAA, and NASA have established an Integrated Program Office (IPO) to create a converged civilian and military weather satellite system called the National Polar-orbiting Operational Environmental Satellite System (NPOESS) to replace the present generation of separate systems. NASA and the IPO are jointly funding the NPOESS Preparatory Project (NPP) that will simultaneously continue key measurements begun by EOS and demonstrate instruments for NPOESS. The NPP will save funding

for NASA, DoD, and NOAA by combining essential atmospheric and Earth surface observations on a single platform, and by seeking to meet both climate science and operational weather requirements with the same advanced instruments.

Earth Science is science in the national interest. ESE leading-edge research and technology gives the world a new view of itself, generating new understanding and myriad practical applications in the economy and society. By combining observations from space with computational models of the Earth system, ESE enables predictions of future climate, weather, and natural hazards that government and industry leaders need to make sound decisions in the years ahead.

Aerospace Technology

This Enterprise works to advance U.S. preeminence in aerospace research and technology. The Enterprise aims to radically improve air travel, making it safer, faster, and quieter as well as more affordable, accessible, and environmentally sound. The Enterprise is also working to develop more affordable, reliable, and safe access to space; improve the way in which air and space vehicles are designed and built; and ensure new aerospace technologies are available to benefit the public. NASA, and its predecessor, the National Advisory Committee for Aeronautics, have worked closely with U.S. industry, universities, and other Federal agencies to give the United States a preeminent position in aeronautics. Activities pursued as part of this Enterprise emphasize customer involvement, encompassing U.S. industry, the Department of Defense, the Federal Aviation Administration, and other NASA Enterprises. NASA is playing a leadership role as part of a Government-industry partnership to develop breakthrough technology that will help the aviation community cut the fatal accident rate five-fold within ten years and ten-fold within twenty years. NASA also supports the development of technologies to address airport crowding; aircraft engine emissions, aircraft noise, and other issues that could constrain future U.S. air system growth. NASA's program to advance space transportation is developing new technologies aimed to create a safe, affordable highway through the air and into space. The targeted technologies will reduce launch costs dramatically over the next decade and increase the safety and reliability of current and future generation launch vehicles. NASA's ability to inspire and expand the horizons of present and future generations rests on the success of these efforts to maintain this nation's leadership in aerospace.

The mission of the Aerospace Technology Enterprise is to pioneer the identification, development, verification, transfer, application, and commercialization of high-payoff aerospace technologies. Through its research and technology accomplishments, this Enterprise promotes economic growth and national security by supporting a safe, efficient national aviation system and affordable, reliable space transportation. In addition, the Aerospace Technology Program supports the development of crosscutting technology to serve the needs of all NASA Enterprises.

To meet this challenge, three main technology goals and one goal for commercialization have been established. Within the three technology goals, a set of objectives has been defined to address current and future National needs. The technologies associated with these objectives are pre-competitive, long-term, high-risk research endeavors with high payoff in terms of market growth, safety, low acquisition cost, consumer affordability and a cleaner environment. The first goal, Revolutionize Aviation, addresses the fundamental, systemic issues in the aviation system to ensure continued growth and development appropriate to the needs of the national and global economies. These systemic issues–safety, capacity, environmental compatibility, and mobility–cut across markets including large subsonic civil transports, air cargo, commuter and general aviation. NASA coordinates its investments and

technology objectives in this area with the Federal Aviation Administration (FAA) and the DoD through the National Research and Development Plan for Aviation Security, Efficiency, and Environmental Compatibility. The second goal, Advance Space Transportation, will create a safe, affordable highway through the air and into space by improving safety, reliability, and operability, while significantly reducing the cost of space transportation systems. With the creation of the Integrated Space Transportation Plan (ISTP), NASA defined a single, integrated investment strategy for all its diverse space transportation efforts, including: Space Shuttle safety investments and competitive sourcing in this decade; the Space Launch Initiative to replace the Space Shuttle with commercially competitive, privately operated reusable launch systems in the next decade, and far-term investments in revolutionary space transportation technologies. NASA is also working closely with the DoD to coordinate requirements and technology developments for reusable launch vehicles. The third goal, Pioneer Technology Innovation, is unique in that it focuses on broad, crosscutting innovations critical to a number of NASA missions and to the aerospace industry in general. Pursuing technology fields that are in their infancy today, developing the knowledge bases necessary to design radically new aerospace systems, developing technologies to radically improve vehicle and science sensor performance and efficiency, and developing tools for efficient, high-confidence design and development, will enable a revolution in aerospace. The fourth goal, Commercialize Technology, is to extend the commercial application of NASA technology for economic benefit and improved quality of life. By partnering with both aerospace and non-aerospace industry as well as academia, the full range of NASA's assets -- technological expertise, new technologies, and research facilities -- are made available to help the Nation.

The Administration's request includes a significant investment in computing and information technology developments and also increases the investment in biotechnology and nanotechnology -- the revolutionary technologies of the 21st Century. To ensure the highest quality research and strong ties to NASA's mission, these investments will be guided by technology development agreements signed by customers in other NASA Enterprises and subject to external, independent reviews. A significant portion of these investments will be externally competed. The Administration's request supports the implementation of six University-based Research, Education, and Training Institutes (RETIs). This will strengthen NASA's ties to the academic community through long-term sustained investment in areas of science and technology critical to NASA's future. To ensure the highest quality research and training and infusion of new ideas, these RETIs will be subject to independent, external reviews and re-competition at regular intervals, including mandatory sunsets after ten years. The Administration's request also supports a 21st Century aerospace vehicle technology effort. This research will develop and verify critical technologies that provide leapfrog capabilities for aerospace vehicles that will be able to change their shape in flight like birds, to optimize performance, perform complex maneuvers in complete safety, and be capable of self-repair when damaged.

Academic Programs

Academic Programs consists of two components, the Education Program and the Minority University Program. Together, these two components of the Academic Programs budget provide guidance for the Agency's interaction with both the formal and informal education community. Since the creation of NASA, the agency has made a substantial commitment to education. NASA's contribution to education has been and is based on the Agency's inspiring mission, specialized workforce, close working relationship with the research and education community, and unique world-class facilities. Based on these attributes, NASA has created a comprehensive education program containing a portfolio of activities directed toward education at all levels. The guidance for the Education Program stated in the NASA Strategic Plan: "Educational Excellence: We involve the educational community in

our endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds." NASA's Education Program brings students and educators at all levels into its missions and its research as participants and partners, providing opportunities for a diverse group of students and educators to experience first hand involvement with NASA personnel, facilities, and research and development activities.

The Minority University Research Program has a goal to: expand NASA's research base by strengthening the research capabilities of minority universities and colleges; to contribute to the scientific and technological workforce; and to promote educational excellence. The range of activities conducted under this program will continue to capture the interest of all students in science and technology, develop talented students at the undergraduate and graduate levels, provide research opportunities for students and faculty members at NASA centers, and strengthen and enhance the research capabilities of the Nation's colleges and universities.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
FISCAL YEAR 2003 ESTIMATES
(IN MILLIONS OF REAL YEAR DOLLAR)

	FY 2001* OP PLAN REVISED	FY 2002 INITIAL OP PLAN	FY 2003 PRES BUDGET
HUMAN SPACE FLIGHT	**7,153.5**	**6,830.1**	**6,130.9**
INTERNATIONAL SPACE STATION	2,127.8	1,721.7	1,492.1
SPACE SHUTTLE	3,118.8	3,272.8	3,208.0
PAYLOAD & ELV SUPPORT	90.0	91.3	87.5
HEDS INVESTMENTS AND SUPPORT	1,247.8	1,214.5	1,178.2
SPACE COMMUNICATIONS & DATA SYSTEMS	521.7	482.2	117.5
SAFETY, MISSION ASSURANCE & ENGINEERING	47.4	47.6	47.6
SCIENCE, AERONAUTICS & TECHNOLOGY	**7,076.5**	**8,047.8**	**8,844.5**
SPACE SCIENCE	2,606.6	2,867.1	3,414.3
BIOLOGICAL & PHYSICAL RESEARCH	362.2	820.0	842.3
EARTH SCIENCE	1,762.2	1,625.7	1,628.4
AEROSPACE TECHNOLOGY	2,212.8	2,507.7	2,815.8
ACADEMIC PROGRAMS	132.7	227.3	143.7
INSPECTOR GENERAL	**22.9**	**23.7**	**24.6**
TOTAL AGENCY	**14,253.2**	**14,901.7**	**15,000.0**

*FY 2001 restructured to reflect two-appropriation structure

NOTE: Full funding for Federal retiree costs not included (see next page)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
FISCAL YEAR 2003 ESTIMATES
(IN MILLIONS OF REAL YEAR DOLLAR)
FEDERAL RETIREE COST DISTRIBUTED BY ENTERPRISE IN FY 2003

	FY 2001* OP PLAN REVISED	FY 2002 INITIAL OP PLAN	FY 2003 PRES BUDGET
HUMAN SPACE FLIGHT	**7,153.5**	**6,830.1**	**6,172.9**
INTERNATIONAL SPACE STATION	2,127.8	1,721.7	1,492.1
SPACE SHUTTLE	3,118.8	3,272.8	3,208.0
PAYLOAD & ELV SUPPORT	90.0	91.3	87.5
HEDS INVESTMENTS AND SUPPORT	1,247.8	1,214.5	1,220.2
SPACE COMMUNICATIONS & DATA SYSTEMS	521.7	482.2	117.5
SAFETY, MISSION ASSURANCE & ENGINEERING	47.4	47.6	47.6
SCIENCE, AERONAUTICS & TECHNOLOGY	**7,076.5**	**8,047.8**	**8,918.5**
SPACE SCIENCE	2,606.6	2,867.1	3,428.3
BIOLOGICAL & PHYSICAL RESEARCH	362.2	820.0	851.3
EARTH SCIENCE	1,762.2	1,625.7	1,639.4
AEROSPACE TECHNOLOGY	2,212.8	2,507.7	2,855.8
ACADEMIC PROGRAMS	132.7	227.3	143.7
INSPECTOR GENERAL	**22.9**	**23.7**	**25.6**
TOTAL AGENCY	**14,253.2**	**14,901.7**	**15,117.0**
[TOTAL AGENCY INCLUDING RETIREES COST]	**[14,357.2]**	**[15,012.7]**	**15,117.0**

*FY 2001 restructured to reflect two-appropriation structure

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
FISCAL YEAR 2002 ESTIMATES
SUMMARY RECONCILIATION OF APPROPRIATIONS TO BUDGET PLANS
(IN MILLIONS OF REAL YEAR DOLLARS)

	TOTAL	Human Space Flight	Science, Aero & Technology	Mission Support	Inspector General
FISCAL YEAR 2001	**14,035.3**	**5,499.9**	**5,929.4**	**2,584.0**	**22.0**
VA-HUD Independent Agencies Appropriations Act, FY 2001 (P.L. 106-377) as passed by Congress, Direction included in Conference Report (H.R. 106-988)	250.0	-37.0	261.3	24.7	1.0
FY 2001 RESCISSION (P.L. 106-554)	-31.4	-12.0	-13.6	-5.7	-0.05
TRANSFER TO OTHER AGENCIES (P.L. 106-554)	-0.7			-0.7	
LAPSE OF FY 2001 UNOBLIGATED FUNDS	-1.8			-1.79	-0.05
TOTAL FY 2001 BUDGET PLAN	**14,251.4**	**5,450.9**	**6,177.1**	**2,600.5**	**22.9**
FISCAL YEAR 2002 REQUEST	**14,511.4**	**7,296.0**	**7,191.7**	**--**	**23.7**
VA-HUD Independent Agencies Appropriations Act, FY 2002 (P.L.107-33) as passed by Congress, direction included in Conference Report (H.R, 107-272)	281.8	-383.6	665.4		
TRANSFERS PER NATIONAL AERONAUTICS AND SPACE ACT AS AMENDED BY P.L. 106-377	--	-158.3	158.3		
DOD APPROPRIATIONS ACT, FY 2002 (HR 3338)	108.5	76.0	32.5		
TOTAL FY 2002 BUDGET PLAN	**14,901.7**	**6,830.1**	**8,047.9**	**--**	**23.7**

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PROPOSED APPROPRIATIONS LANGUAGE

ADMINISTRATIVE PROVISIONS

Notwithstanding the limitation on the availability of funds appropriated for "Human space flight", or "Science, aeronautics and technology" by this appropriations Act, when any activity has been initiated by the incurrence of obligations for construction of facilities as authorized by law, such amount available for such activity shall remain available until expended. This provision does not apply to the amounts appropriated for institutional minor revitalization and construction of facilities, and institutional facility planning and design.

Notwithstanding the limitation on the availability of funds appropriated for "Human space flight", or "Science, aeronautics and technology" by this appropriations Act, the amounts appropriated for construction of facilities shall remain available until September 30, **[**2004**]** *2005.*

Notwithstanding the limitation on the availability of funds appropriated for the "Office of Inspector General", amounts made available by this Act for personnel and related costs and travel expenses of the National Aeronautics and Space Administration shall remain available until September 30, **[**2002**]** *2003* and may be used to enter into contracts for training, investigations, costs associated with personnel relocation, and for other services, to be provided during the next fiscal year. Funds for announced prizes otherwise authorized shall remain available, without fiscal year limitation, until the prize is claimed or the offer is withdrawn.

[No funds in this or any other Appropriations Act may be used to finalize an agreement prior to December 1, 2002 between NASA and a nongovernment organization to conduct research utilization and commercialization management activities of the International Space Station.**]** *(Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 2002)*

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PROPOSED APPROPRIATIONS LANGUAGE

HUMAN SPACE FLIGHT*
(INCLUDING TRANSFER OF FUNDS)

For necessary expenses, not otherwise provided for, in the conduct and support of human space flight research and development activities, including research, development, operations, support and services; maintenance; construction of facilities including repair, rehabilitation, revitalization and modification of facilities, construction of new facilities and additions to existing facilities, facility planning and design, environmental compliance and restoration, and acquisition or condemnation of real property, as authorized by law; space flight, spacecraft control and communications activities including operations, production, and services; program management; personnel and related costs, including uniforms or allowances therefor, as authorized by 5 U.S.C. §§ 5901- 5902; travel expenses; purchase and hire of passenger motor vehicles; not to exceed **[**$20,000**]** *$24,000* for official reception and representation expenses; and purchase, lease, charter, maintenance and operation of mission and administrative aircraft, **[**$6,912,400,000**]** *$6,172,900,000* to remain available until September 30, **[**2003**]** *2004*, of which amounts as determined by the Administrator for salaries and benefits; training, travel and awards; facility and related costs; information technology services; science, engineering, fabricating and testing services; and other administrative services may be transferred to the "Science, aeronautics and technology" in accordance with section 312(b) of the National Aeronautics and Space Act of 1958, as amended by Public Law 106-377. *(Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 2002; additional authorizing legislation required.)*

** - (includes Federal Retiree Costs – see Special Issues section)*

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PROPOSED APPROPRIATIONS LANGUAGE

SCIENCE, AERONAUTICS AND TECHNOLOGY*
(INCLUDING TRANSFER OF FUNDS)

For necessary expenses, not otherwise provided for, in the conduct and support of science, aeronautics and technology research and development activities, including research, development, operations, support and services; maintenance; construction of facilities including repair, rehabilitation, revitalization and modification of facilities, construction of new facilities and additions to existing facilities, facility planning and design, environmental compliance and restoration, and acquisition or condemnation of real property, as authorized by law; space flight, spacecraft control and communications activities including operations, production, and services; program management; personnel and related costs, including uniforms or allowances therefor, as authorized by 5 U.S.C. §§ 5901- 5902; travel expenses; purchase and hire of passenger motor vehicles; not to exceed $20,000 ***[****$24,000****]*** for official reception and representation expenses; and purchase, lease, charter, maintenance and operation of mission and administrative aircraft, **[**$7,857,100,000**]** *$8,918,500,000*, to remain available until September 30, **[**2003**]** *2004*, of which amounts as determined by the Administrator for salaries and benefits; training, travel and awards; facility and related costs; information technology services; science, engineering, fabricating and testing services; and other administrative services may be transferred to the Human Space Flight account in accordance with section 312(b) of the National Aeronautics and Space Act of 1958, as amended by Public Law 106-377**[**, except that no funds may be transferred to the program budget element for Space Station**]**. *(Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 2002; additional authorizing legislation required.)*

OFFICE OF INSPECTOR GENERAL*

For necessary expenses of the Office of Inspector General in carrying out the Inspector General Act of 1978, as amended, **[**$23,700,000**]** *$25,600,000*. *(Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 2002; additional authorizing legislation required.)*

** - (includes Federal Retiree Costs – see Special Issues section)*

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 2003 ESTIMATES

DISTRIBUTION OF PROGRAM AMOUNT BY INSTALLATION
(Millions of Dollars)

	Total			Human Space Flight			Science, Aeronautics and Technology		
	2001	2002	2003	2001	2002	2003	2001	2002	2003
Johnson Space Center	4,297.0	4,209.3	3,687.4	4,086.5	3,933.8	3,394.7	210.5	275.5	292.7
Kennedy Space Center	931.9	1,058.5	921.9	699.0	797.8	664.5	232.9	260.7	257.4
Marshall Space Flight Center	2,202.4	2,327.9	2,526.9	1,602.9	1,349.6	1,207.0	599.5	978.3	1,319.9
Stennis Space Center	245.2	198.9	173.8	83.0	89.6	91.2	162.2	109.3	82.6
Ames Research Center	722.2	739.0	708.6	80.9	14.3	7.2	641.3	724.7	701.4
Dryden Flight Research Center	217.6	200.0	193.3	36.9	22.1	10.1	180.7	177.9	183.2
Langley Research Center	664.8	735.3	722.7	19.4	13.8	14.3	645.4	721.5	708.4
Glenn Research Center	641.2	632.8	731.3	125.3	42.2	46.5	515.9	590.6	684.8
Goddard Space Flight Center	2,467.6	2,645.5	2,560.4	183.9	198.0	69.0	2,283.7	2,447.5	2,491.4
Jet Propulsion Laboratory	1,390.8	1,368.6	1,416.4	147.6	185.6	15.2	1,243.2	1,183.0	1,401.2
Headquarters	449.3	762.1	1,332.7	88.1	183.3	611.2	361.2	578.8	721.5
Undistributed:									
Inspector General	22.9	23.7	24.6						
TOTAL NASA	14,253.2	14,901.7	15,000.0	7,153.5	6,830.1	6,130.9	7,076.5	8,047.8	8,844.5

*FY 2001 restructured to reflect new FY 2002 Two Appropriation Structure

**Full funding for Federal Retiree Cost are not included (see Special Issues)

Note: totals may not add due to rounding